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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/775,514	02/10/2004	Jack Oon Chu	YOR920010308US3 (16315B)	1038
23389	7590	04/20/2006	EXAMINER	
SCULLY SCOTT MURPHY & PRESSER, PC 400 GARDEN CITY PLAZA SUITE 300 GARDEN CITY, NY 11530			MONDT, JOHANNES P	
			ART UNIT	PAPER NUMBER
			3663	

DATE MAILED: 04/20/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

<b>Office Action Summary</b>	<b>Application No.</b> 10/775,514	<b>Applicant(s)</b> CHU ET AL	
	<b>Examiner</b> Johannes P. Mondt	<b>Art Unit</b> 3663	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

#### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

#### Status

- 1) ☒ Responsive to communication(s) filed on 31 January 2006.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

#### Disposition of Claims

- 4) ☒ Claim(s) 29 and 32-60 is/are pending in the application.
- 4a) Of the above claim(s) 42-59 is/are withdrawn from consideration.
- 5) ☒ Claim(s) 33-38, 40 and 41 is/are allowed.
- 6) ☒ Claim(s) 29, 32 and 60 is/are rejected.
- 7) ☒ Claim(s) 39 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

#### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 2/10/04 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

#### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \*    c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

#### Attachment(s)

- |   |   |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)   | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)  | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date <u>4/16/06</u> . (NB: replacing old PTO-1449) | 6) <input type="checkbox"/> Other: _____  |

## **DETAILED ACTION**

### ***Continued Examination Under 37 CFR 1.114***

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 1/31/06 has been entered.

### ***Response to Amendment***

Amendment filed 1/31/06 with said Request for Continued Examination forms the basis for this office action.

The Declaration under 37 CFR 1.132 filed 1/31/06 is insufficient to overcome the objection based on 37 CFR 1.83(a) to the Drawings. It is not the possibility in principle that the claimed subject matter is feasible to be carried out that is in doubt, but instead the disclosure, even with interfaces indicated as allegedly shown by a Replacement Sheet for Figure 2, does not illustrate the Si/SiC interface having an abrupt change in C concentration of more than  $1 \times 10^{18}$  atoms/cc over a layer thickness in the range from about 6 to 60 Angstroms as recited in claims 29, 32, 33, 34 and 60, as well as claims dependent thereon. Rather than Figure 2, which by its nature as a mere photograph cannot be expected to show the kind of resolution as claimed. However, none of the graphs showing the carbon concentration for the elected invention shows the claimed abrupt change quantitatively, while it is their purpose to quantify the carbon

concentration as a function of depth. Therefore, the objection to the Drawings is herewith repeated. Comments on Remarks with regard to the rejections in the previous office action, submitted with said Amendment, are included below under "Response to Arguments".

### ***Information Disclosure Statement***

Examiner acknowledges receipt of a readable copy of IDS item Kasper et al (IDS filed 5/5/05. A signed copy of Form PTO-1449 for said IDS replacing the previous copy is herewith enclosed.

### ***Drawings***

1. *The drawings are objected to* under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, the "said Si/SiC interface having an abrupt change in C concentration of more than  $1 \times 10^{18}$  atoms/cc over a layer thickness in the range from about 6 Å to about 60 Å" as recited in claims 29-42 must be shown or the feature canceled from the claims. No new matter should be entered.

Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate

changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

***Claim Rejections - 35 USC § 103***

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. ***Claim 29*** is rejected under 35 U.S.C. 103(a) as being unpatentable over Swanson et al (6,552,375 B2) (previously cited) in view of Edmond (5,061,972).

*Swanson et al* teach a layered structure comprising:

a substrate 202/204/206 having an upper surface of single crystalline Si (the upper surface 206 is single crystalline, see note below) (col. 5, l. 49 – col. 6, l. 12 and col. 4, l. 66 – col. 5, l. 12: N.B.: lattice mismatch between the collector 206 and any other layer above it is disclosed: for this there has to be a definite lattice constant value on its upper surface),

a layer of SiC 218 (col. 6, l. 52-65) over said upper surface, said layer of SiC and said upper surface of single crystalline Si (interface between 218 and Si buffer 216: col. 6, l. 1-5) defining an interface having an abrupt change in C concentration of more than  $1 \times 10^{18}$  atoms/cc over a layer thickness that overlaps with the claimed range of 6 to 60 Å (N.B.: the atomic number density of silicon is  $5 \times 10^{22}$  atoms/cc; the range of the stoichiometric parameter X in  $\text{Si}_{1-x}\text{C}_x$  (for instance  $X=0.002$  corresponds to a concentration of 0.002 times said atomic number density, i.e.,  $1 \times 10^{20}$  atoms/cc and the relation between X versus concentration is linear throughout the range) overlaps with the range as claimed; while the thickness is about 0 – 100 Å, in particular 50 Å: see col. 6, l. 26-43) in 216, it can be concluded that said interface has an abrupt change in C concentration as claimed and over a layer thickness that overlaps with the claimed range.

Applicant is reminded that a *prima facie* case of obviousness typically exists when the ranges of a claimed composition overlap the ranges disclosed in the prior art or when the ranges of a claimed composition do not overlap but are close enough such that one skilled in the art would have expected them to have the same properties. In re Peterson, 65 USPQ2d 1379 (CA FC 2003).

Because the stoichiometric quantification of said interface layer 216 is characterized by zero oxygen concentration the final limitation of claim 29 is also met.

Parenthetically, is noted that the stoichiometric formula  $\text{Si}_{1-x}\text{C}_x$  with great accuracy defines the composition, and does not include any oxygen (loc.cit., see above, in particular col. 6, l. 52-65).

*Swanson does not necessarily teach the limitation that said SiC layer is a single crystalline SiC layer.* However, it would have been obvious to include said limitation in view of Edmond, who, in a patent on a bipolar junctions, hence analogous art, teaches the application of epitaxy to form single crystalline SiC layers (see abstract and col. 4, l. 55-68).

*Motivation* to include the teaching by Edmond in the invention by Swanson stems from the resulting avoidance of diffusion along grain boundaries thus further decreasing the diffusion in the SiC diffusion blocking layer 218 of Swanson.

4. **Claim 32** is rejected under 35 U.S.C. 103(a) as being unpatentable over Swanson et al and Edmond as applied to claim 29 above, and further in view of Fang et al (6,114,745). As detailed above, claim 29 is unpatentable over Swanson et al in view of Edmond. Swanson et al nor Edmond necessarily teach the further limitation defined by claim 32. However, it would have been obvious to include said further limitation in view of Fang et al, who teach the SiC emitter region 40 in a bipolar transistor to be topped by an abutting silicon layer 38 so as to create an emitter contact region (col. 3, l. 2-31). Inclusion of the teaching in this regard by Fang et al in the invention by Swanson implies the selection of polysilicon, hence of silicon, for emitter contact region 126 and is motivated by the more gradual transition in resistivity between the emitter electrode and the silicon carbide portion of the emitter, thus lowering the contact potential, which is the essence of any contact region.

6. **Claim 60** is rejected under 35 U.S.C. 103(a) as being unpatentable over Swanson et al (6,552,375 B2) (previously cited) in view of Edmond (5,506,197).

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Swanson et al teach a layered structure comprising: a substrate 202/204/206 having an upper surface of single crystalline Si (the upper surface 206 is single crystalline, see note below) (col. 5, l. 49 – col. 6, l. 12 and col. 4, l. 66 – col. 5, l. 12: N.B.: lattice mismatch between the collector 206 and any other layer above it is disclosed: for this there has to be a definite lattice constant value on its upper surface), one or more layers of materials selected from the group consisting of Si, SiGe, SiC and SiGeC (namely: SiC 218 (col. 6, l. 52-65)), wherein said one or more material layers comprise at least one layer of SiC or SiGeC (namely: SiC layer 218) (loc.cit.) over said upper surface, and said one or more layers and said upper surface of single crystalline Si define one or more interfaces having an abrupt change in C concentration of more than  $1 \times 10^{18}$  atoms/cc over a layer thickness that overlaps with the claimed range of 6 to 60 Å (N.B.: the atomic number density of silicon is  $5 \times 10^{22}$  atoms/cc; the range of the stoichiometric parameter X in  $\text{Si}_{1-x}\text{C}_x$  (for instance  $X=0.002$  corresponds to a concentration of 0.002 times said atomic number density, i.e.,  $1 \times 10^{20}$  atoms/cc and the relation between X versus concentration is linear throughout the range) overlaps with the range as claimed; while the thickness is about 0 – 100 Å, in particular 50 Å: see col. 6, l. 26-43) in 216, it can be concluded that said interface has an abrupt change in C concentration as claimed and over a layer thickness that overlaps with the claimed range.

Because the stoichiometric quantification of said interface layer 216 is characterized by zero oxygen concentration the final limitation of claim 29 is also met.

Parenthetically, is noted that the stoichiometric formula  $\text{Si}_{1-x}\text{C}_x$  with great



accuracy defines the composition, and does not include any oxygen (loc.cit., see above, in particular col. 6, l. 52-65).

Applicant is reminded that a *prima facie* case of obviousness typically exists when the ranges of a claimed composition overlap the ranges disclosed in the prior art or when the ranges of a claimed composition do not overlap but are close enough such that one skilled in the art would have expected them to have the same properties. In re Peterson, 65 USPQ2d 1379 (CA FC 2003).

Also, Applicants are herewith reminded of the election of species requirement and their election of Species 1. Because of said election newly added claim 60 only at most patentably distinguishes over claim 21 through the limitation “one or more layers” (of SiC) instead of “a layer” (of SiC) and the limitation “one or more interfaces” instead of the limitation “an interface”.

*Swanson does not necessarily teach the limitation that said SiC layer is a single crystalline SiC layer.* However, it would have been obvious to include said limitation in view of Edmond, who, in a patent on a bipolar junctions, hence analogous art, teaches the application of epitaxy to form single crystalline SiC layers (see abstract and col. 4, l. 55-68).

*Motivation* to include the teaching by Edmond in the invention by Swanson stems from the resulting avoidance of diffusion along grain boundaries thus further decreasing the diffusion in the SiC diffusion blocking layer 218 of Swanson.

***Allowable Subject Matter***

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- a. **Claims 33-38, 40 and 41**, subject to a successful removal of the reasons for the objection to the Drawings as made above, would be allowable. The following is a statement of reasons for the indication of allowable subject matter: within the context of the invention as defined by claim 29 the p-type and n-type dopants of said SiC layer were not found in the prior art to have the concentration as recited in claims 33 and 34, respectively.
- b. **Claim 39** is objected to as being dependent upon a base claim, but, subject to a successful removal of the reasons for the objection to the Drawings as made above, would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. The following is a statement of reasons for the indication of allowable subject matter: within the context of the invention as defined by claim 29 the S:Ge layer as recited in claim 39 has not been found in the prior art.

### ***Response to Arguments***

Applicant's arguments filed 1/31/06 have been fully considered but they are not persuasive.

First, the Declaration has been commented upon above under "Response to Amendment".

Annotation of the photograph illustrated in Figure 2 through the inclusion of numerals indicating interfaces cannot possibly, and does nothing to, clarify why a sufficiently resolved graphical representation of the carbon concentration versus depth

as illustrated for the elected invention (Si/SiC) does not show the claimed abrupt change in C concentration to be more than 1018 atoms / cc over a layer thickness in the range from about 6 – 60 Angstroms. Therefore, the objection to the Drawings is maintained.

It is furthermore noted that applicant only now for the first time claims a single crystalline SiC layer.

It is also noted that the amendment to claim 60 introduces non-elected subject matter because only a Si/SiC interface, in contradistinction to Species 2 and 3, with reference to the Restriction Requirement mailed 3/2/05 and applicant's election of Species 1 per Response filed 3/30/05 (without traverse).

Finally, in response to applicant's allegation that examiner has resorted to picking and choosing, and in particular *has not established reasonable expectation of success* in creating the single crystalline structure as claimed given the method by Swanson, applicant is referred to the well-known use of epitaxy (method used by Swanson, see col. 8, l. 45-55) in producing *single crystal SiC* layers in the production of abrupt junctions, as witnessed by Edmond (5,061,972) (see abstract), while, given the thickness of the interface region over which the carbon concentration changes the abrupt change as claimed is met.

In light of the above considerations the new claim language must regrettably be rejected as shown above.

### ***Conclusion***

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Any inquiry concerning this communication or earlier communications from the examiner should be directed to Johannes P. Mondt whose telephone number is 571-272-1919. The examiner can normally be reached on 8:00 - 18:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jack W. Keith can be reached on 571-272-6878. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

JPM  
April 16, 2006

Patent Examiner:



Johannes Mondt (art Unit: 3663)